

ZOOLOGY.—*Marionella* (*Eurystoma* Marion, 1870); *an emendation, with notes on a new birefringent substance, marionellin, found in the intestinal cells.* (*Contributions to a science of Nematology*, XI.)<sup>1</sup> N. A. COBB, U. S. Department of Agriculture.

The name *Eurystoma*, applied by Marion<sup>2</sup> in 1870 to a new genus of free living marine nemas discovered by him near Marseilles, France, was preempted, having been applied by Rafinesque in 1818 to a genus of molluscs. Naturally, investigations, made during the last half century enable one, at the present time, to emend Marion's original description. Having examined as many more new, and as yet unpublished, species of the genus as have been already published, I venture to make this emendation, based on a study of about twenty-five species, and to propose for the genus the new name *Marionella*, in commemoration of its original author.

***Marionella*, nom. nov.**

*Eurystoma* Marion, Ann. Sci. Nat. Zool. V. 13: 19. 1870. Not *Eurystoma* Raf. 1818.

*Cuticle and setae.*—The thin layers of the transparent, colorless cuticle are traversed by transverse striae so exceedingly fine that they are very difficult to see even with highest powers of the microscope. Occasionally oblique striae also are to be seen in the cuticle of the lips, running in the direction of a left-handed screw. There are no lateral wings to the cuticle, and the striae are not altered on the lateral fields. There are no longitudinal striae in the cuticle itself, but the attachments of the somatic muscles give rise to longitudinal markings of a character somewhat resembling true striae. The contour of the body is always plain.

The cephalic setae, which are one-third to two-thirds as long as the lip-region is wide, are six or ten in number. Even when at first sight there appear to be only six, it is frequently found that in reality there are ten,—each of the four submedian setae having a very short and very inconspicuous companion hugging its base. The setae, two lateral and four or eight submedian, are usually slightly curved, of medium size to very slender, tapering, and somewhat acute, and have innervations that are most clearly visible near their bases; they are of medium stiffness to flexible, and spread outward from the lateral surface of the head opposite the apex of the onchium. Occasionally the larger setae *can be seen to be about three-jointed*. There are no special subcephalic setae. On the anterior portion of the neck in the vicinity of the head there are always to be found a few small, slender setae, one-sixth to one-eighth as long as the corresponding body diameter; these usually project at right angles to the neck or incline forward at an angle of sometimes as much as forty-five degrees. Not infrequently among the cervical setae there is one, a dorsal one, two to three times as far back as

<sup>1</sup> Received November 10, 1921.

<sup>2</sup> Ann. Sci. Nat. Zool. V. 13: 19. 1870.

the base of the head, which is more prominent than the others. The somatic setae appear always to be reduced to innervations. There are no conspicuous pores on the surface of the body, but the ellipsoidal glandular cells of considerable size invariably found in the lateral fields are connected with the exterior by means of *very small and inconspicuous pores*.

*Head and pharynx*.—The somewhat rounded to subtruncate head is usually continuous with the neck, but is sometimes set off by a slight constriction, or by a very slight, broad, shallow constriction. The lip-region, on the other hand, is nearly always set off by a very slight, narrow and shallow, but usually distinctly visible constriction. The membranous lips are themselves thin and confluent, and apparently close by virtue of their elasticity. Their margins are very finely striated and possibly sometimes fimbriate. The lips are supplied externally with six forward-pointing papillae (or six sets of papillae), arranged in a single circlet having a diameter about one-half as great as that of the lip-region. These papillae are so exceedingly small as usually to escape observation. Their innervations are also exceedingly inconspicuous. Usually it is only when the papillae happen to project forward a little in exact profile that they come into view.

At first sight the pharynx appears to have the form of that of *Oncholaimus*. It is, however, nearly always *divided into two distinct chambers* of more or less equal length, the anterior of which is somewhat the wider and the more symmetrical. This regular anterior chamber is nearly always a napiform cavity one-half to two-thirds or even three-fourths as wide as the corresponding portion of the head. The posterior chamber is of smaller size, usually only about three-fourths as wide as the anterior chamber, and more or less irregularly spheroidal in form. The refractive walls of the pharynx are well-developed, but not very thick. The pharynx is usually armed with a single *well-developed, forward-pointing onchium*, but there may be one or two additional smaller onchia in exceptional cases. The apex of the main, and usually only, onchium, always occupying the right ventral submedian position, extends forward sometimes as far as the lips. The convex-conoid, enlarged base of the onchium fills the posterior chamber of the pharynx comparatively full. This enlarged portion of the onchium is continued in the front chamber by a narrower, more slowly tapering, convex-conoid, more or less acute summit. This organ is perforated and so serves as the *outlet of a large oesophageal gland*. The posterior pharyngeal chamber is separated from the anterior by a constriction, marked in its most pronounced form by the presence of narrow and refractive, transverse, arcuate elements or thickenings, placed end to end in a circle. Adjacent to this circle, usually in front of it and close together, there are one to three *transverse rows of denticles*, each consisting of either about thirty-two, or about sixty-four to eighty, somewhat forward-pointing units. These more or less inward pointing denticles are rather acute, cylindroid-conoid, uniform in size, and are usually so minute as to be barely resolvable with high powers of the microscope.

When viewed from in front, the pharynx is seen to be very nearly round. The margin of the lip-region is so thin and filmy that oftentimes it is difficult to delimit. An exact count of the denticles in a specimen of an unpublished but typical species, gave the following figures:—anterior series of denticles 62; second series 62; back series of larger denticles 20;—this decreased number in the back row being due not only to the fact that the denticles are larger

and farther apart, but also to fact the that one-third of the circumference is destitute of denticles, namely that part of the circumference opposite the large onchium. In this particular region, however, the interior walls of the pharynx are very finely longitudinally striated. The back row of denticles, it should be pointed out, is on the wall of the posterior half of the pharynx.

The neck is conoid, or occasionally subcylindroid, and ends in a cylindroid or, more often, a rather decidedly convex-conoid head.

*Amphids and eye-spots.*—Though the *amphids* are well-developed, they are rarely plainly to be seen. Their exterior expression consists of *two dorsally sub-lateral concavities* two to three times as wide as long, impinging on the bases of the lateral setae. Though the peripheries of the amphids may seem to be closed, they are, in fact, nearly always found to be open on the posterior margin near the lateral fields. As a rule their contours are almost invisible, so that their form and extent are mainly indicated by the apparent absence in them of the fine structural elements to be seen elsewhere in the cuticle of the head. When clearly defined, their contours are found to be reniform with the convex side forward. They are located on or near the base of the lip-region, and more or less opposite to the rows of denticles. They are usually one-third to two-fifths as wide as the corresponding diameter of the lip-region and two to three times as wide as long.

More often than not two eye-spots are present. These take the form of spheroidal, compact collections of about one hundred brownish granules, each collection lateral in position and lying between the oesophagus and body-wall,—being about one-fourth as wide as the corresponding portion of the neck, and removed from the anterior extremity by a distance two to four times as great as the width of the head. Anteriorly, these ocelli often present a spherical cavity in which there is at least the suggestion of a spherical lens.

*Oesophagus.*—The simple conoid oesophagus is destitute of bulbs and receives the base of the pharynx in its anterior extremity, where it is usually about half as wide as the base of the head. Near the nerve-ring it is usually about one-half, and posteriorly usually about three-fifths, as wide as the corresponding part of the neck. It is always separated from the intestine by a distinct cardiac collum about one-third as wide as the base of the neck. While not conspicuous, the lining of the oesophagus is a distinct feature throughout its length. Though the oesophageal musculature is usually fine, the structure is occasionally coarse in the posterior part. Rarely, yellowish spherical granules are found in the tissues of the oesophagus. The oesophageal glands are well-developed, or at least one of them is; as before stated, they empty into the pharynx through pores in the onchia. The right submedian gland is without exception the largest. There is usually a well-developed conoid or hemispherical cardia one-third to one-half as wide as the corresponding portion of the neck.

*Intestine.*—The intestine becomes at once one-half to two-thirds as wide as the body, and is made up of cells of such a size that few are required to build a circumference. Its walls are thick, and its lumen faint. Its cells invariably contain fine spherical granules of more or less variable size, the largest of them being one-fortieth to one-twentieth as wide as the body. The granules are scattered, or sometimes numerous, in the cells, and may be so arranged as to give rise to a faint tessellated effect, though this is unusual.

*Doubly refractive granules (Marionellin) in the intestinal cells.*—In the single layer of cells composing the intestine, an undescribed species of *Marionella* presented about twenty scattered special cells, more numerous and closer together anteriorly, each packed with doubly refractive granules (marionellin) mostly of very small size. Marionellin occurs in other species of *Marionella*.

These special intestinal cells were not distributed along a definite longitudinal line as in *Ironus*, where there is a decided dorso-ventral symmetry to the intestine due to the dorsal cells having a different character from the ventral. The interspaces between these special cells in this species of *Marionella* increased rather regularly from front to rear.

The discovery of these special intestinal cells is an additional observation indicating differentiation among the cells of the nema intestine. Such differentiated cells are now known to the writer in the following genera, among others: *Enoplus*, *Bathylaimus*, *Ironus*, *Mononchus*, *Eurystoma* (all carnivorous). It seems very reasonable to suppose that these differentiated cells may have functions similar to those of the glands accessory to the intestine of other and larger animals. Assuming that digestion in nemas has a general similarity to that of the higher animals, it would seem that gastric, hepatic, renal and other functions must exist in some form in the nema; thus far, however, very few of these functions can be assigned to special organs, as few or no such special organs exist. Instead of each cell of the intestine carrying out all of these distinct functions, in view of the above observations there is now morphological evidence of "division of labor," and when these differentiated cells have been adequately investigated, we shall probably be able to assign to them definite functions, and, for illustration, be able to apply to them some such terms as "hepatic cells," "renal cells," "splenic cells," etc.

*Tail.*—The tail in *Marionella* takes on one of two distinct forms, according as there is or is not a spinneret present. If there is no spinneret the tail is conoid from the anus to the acute terminus, sometimes however tapering a little more rapidly in the anterior portion than elsewhere. In species possessing this form of tail, usually the tail of the male is the shorter, and the narrow conoid posterior part may appear rather as an appendage to the short but bulky anterior part. Most of the species, however, possess three well-developed unicellular caudal glands and a blunt, conoid, unarmed, and symmetrical terminal spinneret about one-fourth as wide as the base of the tail. If any setae occur on the tail, they are exceedingly small and very inconspicuous. The three quite separate ducts of the caudal glands are plainly visible in the tail and end posteriorly in three separate ampullae. The unicellular glands themselves are arranged in a loose tandem in front of the anus, the foremost being removed a distance from the anus several times as great as the corresponding body diameter.

*Lateral fields: glandular cells.*—The lateral fields are usually about half as wide as the body, and contain large, granular, ellipsoidal, glandular cells about one-third as wide as the body and emptying on the surface of the cuticle by means of exceedingly minute pores. These large glandular cells are situated from point to point throughout the length of the body, the distance between them being from one to four times as great as the width of the body.

*Renette.*—The renette cell is invariably situated behind the neck and empties by means of a long, narrow, faintly visible duct. The narrow in-

conspicuous ampulla is situated nearly opposite the base of the pharynx. The obscure *excretory pore is invariably located in the lip-region* opposite the row of cephalic setae. The presence of the duct and ampulla usually causes the pharynx as well as the portion of the oesophagus near the head to be a little nearer to the dorsal side of the body than to the ventral.

*Nerve-ring.*—The nerve-ring is always a rather conspicuous feature. As a distinct collar it surrounds the oesophagus a trifle obliquely and is of medium size, and has arranged both in front of it and behind it numerous large nuclei, whose grouping, however, does not appear to be very orderly.

*Female organs.*—The female sexual organs are *invariably double and reflexed* ('f'). The vulva, though large, is more or less continuous and not very conspicuous. The well-developed vagina leads inward at right angles to the ventral surface about two-fifths of the way across the body, and, though fairly muscular, is not very amply cutinized.

The two straight uteri are of such a size as to contain two or more eggs at a time, arranged tandem; these latter are thin-shelled, smooth, usually ellipsoidal or somewhat elongated, and are deposited before segmentation begins. The reflexed ovaries are broad, or of medium width, taper more or less, and extend one-half to two-thirds the distance back to the vulva. The ova in them are arranged single file except near the blind end, where they are arranged irregularly.

*Male organs.*—The tail of the male is like that of the female except that it is usually shorter and more pronounced in its features, especially in species lacking a spinneret. In all the species that have been carefully examined in this respect, namely in the majority of the species, there are *two outstretched testes* extending in opposite directions, the anterior one ending a neck-length or more behind the cardia, the other near the beginning of the posterior fourth of the body. The two equal spicula are invariably arcuate, and occasionally strongly so. At their widest part they are one-sixth to one-eighth as wide as the corresponding portion of the body. They are from one and one-fourth to two times as long as the anal body diameter, and when viewed in profile their proximal ends appear to lie opposite to or slightly dorsad from the body axis,—very rarely ventrad. The proximal ends are almost always very slightly cephalated by expansion, but they are sometimes faintly cephalated by constriction or by contraction. They are somewhat slender, of rather uniform width, and rather blunt at the free end, where they sometimes terminate in a simple or denticulate crochet. The gubernaculum, placed at right angles to the distal parts in the spicula, though sometimes of uniform width, usually tapers internally to a blunt or acute point, which lies opposite to or dorsad from the body diameter. From this apophysis muscles lead fore and aft to the dorsal body wall. The portion of the gubernaculum applied to the spicula is one-sixth to one-eighth as long as these latter.

*Supplementary organs.*—Invariably *two large, ventral, pre-anal supplementary organs are present*, though in a few species they are more or less vestigial. They are placed in front of the anus in such fashion that the posterior one is about as far in front of the anus as the spinneret is behind it, and the anterior one about as far in front of the posterior as this latter is in front of the anus. There is, however, some variation in the situation of this pair of supplementary organs in the different species. Nearly always the posterior supplement is a little smaller than the anterior, some-

times markedly so. When well-developed, these organs consist of highly refractive elements, both external and internal, which are *very striking in their appearance*. To a considerable extent these supplements can be *protruded and withdrawn*. When protruded they are very prominent. When withdrawn they may leave the ventral contour comparatively even; and yet, even when withdrawn, they are hardly less conspicuous than when protruded, owing to their highly refractive character. The most striking internal elements are two in number to each supplement, extending, one forward and the other backward, and may *appropriately be termed "levers."* These levers are somewhat finger-shaped pieces of cutinized material that serve for the attachment of muscles. They usually taper but little, and their internal extremities are invariably blunt. The two levers of a given supplement are usually practically equal in size. When the supplement is at rest, the levers lie near the ventral side of the body and parallel to it. In such circumstances the exterior portion of the organ protrudes only slightly; but when the free inner ends of the levers are drawn inward so that they lie at an angle with the ventral surface, sometimes as great an angle as forty-five degrees, the external portions of the supplements are protruded. The external portion of each organ has the form of a laterally compressed cup, or trough, whose profile is exteriorly flat, or more often slightly concave, and interiorly more or less semi-circular. While the depth of the organ may sometimes equal its width, often it is less, and sometimes only one-half or one-third as great. Those species showing the maximum development of the supplementary organs present cases where the depth of the organ is one-fourth as great as the corresponding diameter of the body. In one species the supplementary organs are asymmetrical, the anterior lever or anchor having become vestigial, and the anterior portion of the cup or trough having diminished relatively in size, so that the contour of the longitudinal section of the organ is triangular rather than semicircular. By means of a duct each supplementary organ is *connected internally and forward with a large glandular cell*, as in *Bolbella*.

*Setae on the male*.—Just in front of the anus on the male there are usually to be found a few minute setae, either ventral or subventral in position. They are very short and very inconspicuous. There may be a single one at the anus; more often there are one or two subventral ones on each side. Occasionally there are two rows extending to near the posterior supplement. These setae are arcuate, acute, and when two are present on each side of the anus, one of the pair is usually located immediately behind the other and is of smaller size. No other papillae or setae have been observed on the tail end of the male. There is no bursa.

*Habitat*.—The genus *Marionella* has hitherto been supposed to be of rather small size. It is in reality large, and is widespread in the various oceans. While the individuals of a given species may not be numerous, or very widespread, the number of specific forms observed is yearly augmenting. The two sexes are about equally common.

The genus is most nearly related structurally to *Bolbella*, *Symplocostoma*, *Thoönchus* and *Catalaimus*.

*Marionella spectabilis* (Marion) is still retained as the type species.